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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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Dated 14 December 2004

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1/77

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P01/7700 0.00-0323582.7

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference WJN/P35835GB

2. Patent application number *(The Patent Office will fill in this part)* 0 8 OCT 2003 0323582.7

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Incode International Limited
PO Box 3136
Road Town
Tortola
British Virgin Islands

Patents ADP number *(if you know it)* 8729014001

If the applicant is a corporate body, give the country/state of its incorporation Bahamas

4. Title of the invention

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Kilburn & Strode
20 Red Lion Street
London
WC1R 4PJ

Patents ADP number *(if you know it)* 125001

~~Kilburn & Strode~~ ~~20 Red Lion Street~~ ~~London~~ ~~WC1R 4PJ~~

ES1/77 10-12-04
Reddie & Grose
16 Theobalds Road
LONDON
WC1X 8PL
91001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

P nts Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	13
Claim(s)	6
Abstract	
Drawing(s)	4 + 4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 6 Oct 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

NEOBARD, William John
Tel: 020 7539 4200

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Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

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Modelling 3-D Objects

The present invention relates to a system for modelling a three-dimension object and to a method of modelling a three-dimensional object.

There is a growing need in the general field of design for a simple and rapid technique for modelling and modifying models of objects, for example to allow the creation of objects whose design is suitable for a particular environment. A non exhaustive list of such objects includes car interiors, boat interiors, aircraft cabin layouts, retail outlet layouts including racking, shelving etc, roofs, lighting and other electrical installations, warehouses, furniture, buildings such as houses and factories, and gardens or parks.

A number of design and visualisation programs are currently available but these lack a simple user interface and also lack the ability to be customised for a particular application. For example in the general field of interior design, although it may be possible to provide a reasonable simulation of an interior space of a building, it is not readily possible to provide flexibly variable images of furniture and accessories to enable the features of the design to be appreciated. Moreover it is not readily possible to address issues of the general design and utility of the rooms of a building by creating a simulation of the rooms and then by testing the design by trying different furniture items and accessories so as adaptively to modify the design of the building to achieve optimal effect.

Although such desiderata could be met by writing custom programs for particular functions, there is a need for a tool that enables rapid visualisation of

objects within an environment, with the facility to vary either or both of the objects and the environment at will. There is a further need in the art for such a tool to enable a manufacturing report readily to be derived from a model of such an environment containing objects, which model is capable of display as a visual report.

According to a first aspect of the present invention there is provided a method of modelling a three-dimensional object, the method comprising defining a frame representing a three-dimensional space for the object, wherein the frame has associated to mention data, displaying an image representing the frame, selecting a component from a library of components, displaying an image of the selected component, and applying the selected component to the frame, wherein the applying step comprises accessing the dimension data of the frame, adapting the component to the frame, and displaying the adapted component in the frame, wherein the adapted component represents at least part of the object.

Where the object is a roof, the frame may represent the roof envelope and the components include tiles, ridge tiles and under-tile felt, bathrooms etc. The roof can, by use of embodiments of the invention, be modelled and reports thereby be generated showing either the visual appearance of the roof, or the component count to enable quantity listings, or both.

Where the object is an item of furniture, the frame may represent an envelope of the item of furniture and the components include top, bottom, side, door and drawer components of the item of furniture. Other fields of application are mentioned above.

In an embodiment the frame comprises constraint data and the component comprises compliance data, wherein the applying step comprises testing the compliance data to determine whether it conforms to the constraint data and thereby controlling the step of displaying the adapted component in the frame.

In an embodiment constraint data comprises specification data specifying allowed components for the said frame, and the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed for the said frame.

For example, where the frame represents a frame for an item of furniture, the constrain data may specify only furniture-type components so that if a user attempts to select a non-furniture component such as a roof tile, the selected component could not be displayed in the furniture item frame.

In an embodiment constraint data comprises specification data specifying at least one allowed orientation of at least one component for the said frame and if applying the step comprises disposing the component in a chosen orientation, the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen orientation for the said frame.

If for example the selected component were a side panel of a furniture item, and the constraint data for the portion of the frame under consideration specified only top panels for that location, in an embodiment the controlling step prevents display of the side panel in an incorrect orientation.

In an embodiment the constraint data comprises specification data specifying at least one allowed disposition of at least one component for the said frame, wherein the applying step comprises disposes the component in a chosen disposition and the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen disposition for the same frame.

For example, if the location on the frame required a top panel and the selected component were instead a bottom panel then the discrepancy between the "top" requirement of the constraint data by differing from the "bottom" attribute of the compliance data may, in embodiments, prevent display of the component in the wrong disposition.

In many embodiments the method comprises selecting at least one further component from the library, displaying the selected further component and applying the selected further component to the frame, wherein the applying step comprises accessing the dimension data of the frame, adapting the further components to the frame and displaying the adapted further component in the frame.

In this way, a model of a complete object can be provided.

In embodiments the method comprises modifying at least one of the size, orientation or disposition of the frame, whereby the or each displayed component varies correspondingly.

In a simple case modification of the size of the frame can merely cause the

displayed components to vary proportionately.. Hence, for example, where a cabinet having two doors is varied in size, the doors vary as the image of the cabinet is varied. However, often there is a need to allow for more complex rules to be followed. For example where a chest of drawers is increased in height, the number of drawers may need to vary so as to maintain the correct proportion. Again, one part of a component may vary differently to another, and some parts (such as handles and spacings of keyholes from the edge of an object) may be of constant dimension.

Accordingly to a second aspect of the present invention there is provided a method of deriving manufacturing data for a three-dimensional object comprising the method of the first aspect and further comprising outputting data derived from the adapted frame and adapted components as manufacturing data.

It will be understood that the processing steps that are necessary to provide a model of an object composed of its various components, can in embodiments be rapid processing steps especially where the prime need is for a report showing a visual image. A suitable technology is Direct-X. Embodiments are also capable of textual reports including quantity data and cost information.

According to a third aspect of the present invention there is provided a system constructed and arranged for modelling a three-dimensional object, the system comprising a component store for storing a library of components and a user input device operable to define a frame representing a three-dimensional space for the object, to select a component from the library of components, and to apply the selected component to the frame. The system comprises a display screen for displaying the frame and for displaying the selected component, and

a processor for running a stored program operably to derive dimension data for the frame, to access the dimension data of the frame, to adapt data representing the component to the dimension data of the frame and to provide the adapted data to the display screen whereby the display screen displays the adapted component in the frame as at least part of the object.

In an embodiment the system further comprises a frame store for plural frame types, each said type having associated data representing constraint, wherein the user input device is operably to select a frame type from said plural frame types, and each component of said library of components has associated data representing compliance information, wherein the stored program is operably to test the compliance data of a selected component to determine whether it conforms to the constraint data of the selected frame type and therefore controlling adaptation of said data representing the components to affect the display of the adapted component in the frame.

In an embodiment the constraint data comprises specification data specifying at least one of the group comprising allowed components for the said frame, and allowed orientation of at least one component for the said frame type and an allowed disposition of at least one component for the said frame type.

In an embodiment the stored program is operable to adapt the component data if the compliance data of the selected component indicates that the selected component is allowed for the said frame type.

In an embodiment the user device is arranged to allow a user to choose an orientation for the selected component, and the stored program is operable to

adapt the component data to represent the chosen orientation to thereby enable display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen orientation for the said frame type.

In an embodiment the user input device is arranged to allow a user to chose a disposition for the selected component, and the stored program is operable to adapt the component data of the selected component to represent the chosen disposition of the component to thereby enable display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen disposition for the said frame type.

In an embodiment the user input device is operable to allow a user to modify at least one of the sides, orientation and disposition of the frame, and the stored program is operable to corresponding adapt the component data for the or each component displayed in the frame whereby the object displayed varies.

An embodiment of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 shows a block diagram of a computer system implementing a method embodying the invention;

Figure 2 shows an exemplary screen of a device implementing a method embodying the invention;

Figure 3 shows an image of a chest of drawers in two configurations; and

Figure 4 shows an illustrative data structure .

In the various figures like reference numerals refer to like parts.

As will be clear to those skilled in the art the present invention requires the use of frames and components. In the present context a frame is a three-dimensional construct which has the following properties.

1. Frames may be constructed or varied by a designer or may be derived from a series of fundamental frames.

2. Frames may be added together.

3. Frames may be disposed within other frames. If this happens and where a parent frame has a co-ordinate system the child frame may or may not be linked to the co-ordinate system.

4. Frames may be hierarchically arranged. For example a building can be regarded as a hierarchly related series of frames including a site frame, an external frame for the building structure, room frames (which must fit within the structure) and furniture frames. Each of these frame types has associated data which allows different components to be placed in the frames. Furthermore, each frame type will respond differently to adjoining frames.

5. Frames can contain not only three-dimensional geometry which determines the display characteristics of components but may also contain attribute data relevant to the particular type of frame. An example is that a room frame is likely to have information indicative of which portion is to be a floor, which to be a ceiling, which to be an external wall and which to be an internal wall.

The Frame will always define a 3D space but it may have additional data attached to or associated with the frame. For instance when considering

different types of rooms different room frames may have differing data attached to them. This non visual data may be attached to the frame and not through subsequently applied components

The skilled person will also be aware that the invention requires the use of components. Components are parametric, possibly composite, data constructs whose geometric parameters are defined by the frame into which the construct is "placed". In one series of embodiments the system of the invention uses a graphical user interface, and the components are applied to their frames by dragging and dropping.

It is envisaged that specific embodiments of the invention are customised for particular applications. Thus the method and system of the invention in its general sense relates only to a method and system for modelling objects. However, specific embodiments are envisaged as including custom content so that for example one embodiment could relate entirely to the design, modelling and visualisation of interior design of buildings, another embodiment to garden design and another embodiment to housing development planning. In such embodiments, the custom content of the particular embodiment is held separate from the underlying processes. The custom information may be formed by the use of an XML file system.

Referring now to Figure 1. A system (1) for modelling a three-dimensional object comprises a component store (10) for storing a library (11) of components, and a user input device (20) such as a keyboard, mouse or the like which is operable to define a frame (200-see Figure 2). The frame represents a

three-dimensional space for the object to be modelled. The user input device is connected to a processor (30) via a link shown figuratively as (25). The processor (30) is connected to a display device (100) via a link shown as (105) the display device having a display screen (101). The processor (30) is further connected to a component memory (10) storing a library (11) containing plural components via a link (15) and to a frame memory (50) storing a library (51) of frames via a link (55). The processor (30) is further connected to a stored program (45) held in memory via a link (35).

Referring now to Figure 2 which shows a portion of a display of the system in use it will be seen that a frame (200) has been defined. In one embodiment the frame (200) is defined by use of the user input device (20), for example by means of a graphic user interface and by clicking with a mouse on the corners of the frame. In another embodiment a number of basic frame configurations are held in the library (51) and one of these is selected for display on the display screen, the user input device (20) being used to manipulate the basic frame to have the required aspect ratios and orientation.

The frame (200) shown in Figure 2 is a wire frame having edges defining six sides (201-206) of which (206) is a bottom, (204) is a top, (203 and 205) are respectively back and front and (201, 202) are respectively sides of an object. In the presently described embodiment the object to be modelled and constructed is a chest of drawers (see Figure 3).

Figure 2 further shows an exemplary extract from the library (11). The extract shows a flat panel (212), a drawer front (213), a triangular element (214) and a flexible element (215).

Referring to Figure 4. A schematic representation of the data for the frame (200) is shown. It will be seen that, in this embodiment, the data constructs (200) includes data for each of the six sides of the frame (200) and the data associated with the side (201) is shown in further detail. This data includes data herein referred to as constraint data (300) which affects whether or not a particular component can be located on the side (201) and also contains other data (320) which, for example, affects how the side (201) relates to other frames. The data (301) of this embodiment comprises three sets of data (301, 302 and 303). The constraint data (300) specifies components that are allowed to be applied to the side (201). In turn each component has compliance data associated with it and there must be full compliance with the constraints (301-303) before a component can be applied to the side (201). In the presently described embodiment constraint data (301) specifies the general nature of the components which is acceptable so that, for example, a drawer front (213) cannot be applied to dress the side (201). The second constraint (302) relates to the orientation of a component so that a component (216) which is intended as a work surface having substantial weight and rigidity suitable only for horizontal orientation can be applied to the side (201). The third constraint (303) relates to the disposition of components. The major function of this dispositional constraint is to prevent a bottom panel from being placed in the position for a top panel, or vice versa.

Returning now to Figure 2, it will now be assumed that the only component that is suitable for the side (201) is the flat panel (212). In practice of course there may be a number of possible components that are suitable for the side (201), and indeed these components may in fact be "completed" frames.

For example the panel (212) in some embodiments is a frame which is dressed by application to it of a component having attributes determined by its material, for example a real wood, a laminate or a fabric finish.

Having selected the component (212), whether it be a component in its own right or a construct of a frame dressed with components at a lower level, the plate (212) is selected and dragged and dropped to be disposed within the side (201).

The stored program which in the present embodiment uses a graphic descriptor language, then modifies the data representing the plate (212) so as to make it fit over the side (201). The adapted component is then displayed in place of the opening (201) of the wire frame (200).

Other suitable components are then applied to dress the frame until the desired chest of drawers has been completed.

The chest of drawers object – see Figure 3 can then be manipulated as an object.

For example it can be placed within a model of a room along with other objects. Such a placing may show that the proportions of the chest of drawers (or indeed the room) need to be modified. If modification of the chest of drawers is necessary, this can be performed by using the user input device to stretch or respectively shrink the dimensions. Where desired the change to the shape or other properties of the chest of drawers may leave other features of the chest of drawers (for example the number of drawers) unchanged. However, it is also

envisaged that the configuration of the chest of drawers may automatically vary - for example see Figure 3 in which the double drawers at the top of the chest of drawers are replaced by a single double-width drawer.

As previously noted, embodiments of the invention have two parts, a general purpose engine part and a custom part for use in a part and/or technical field. The custom part may be implemented at least partly in XML. The custom part may include one or more component and/or frame libraries, and may include data for determining the GUI layout on screen. It may also enable or disable selected parts of the engine part – for example, a roof design application may not require rotation of a roof structure out of the horizontal plane, and hence an embodiment customised for roof design can have the rotation tool provided in the engine disabled by the custom part.

An embodiment of the invention has now been described in the context of furniture design. It should be understood, however, that the invention is not restricted to furniture design and may be used in many fields of technology. More specifically the described features of the embodiment are not to be taken as limiting on the invention which is defined in the appended claims.

1. A method of modelling a three-dimensional object, the method comprising

defining a frame representing a three dimensional space for the object, wherein the frame has associated dimension data;

displaying an image representing the frame;

selecting a component from a library of components;

displaying an image of the selected component; and

applying the selected component to the frame,

wherein the applying step comprises:

accessing the dimension data of the frame;

adapting the component to the frame; and

displaying the adapted component in the frame,

wherein the adapted component represents at least part of the object.

2. A method according to claim 1, wherein the frame comprises constraint data, and the component comprises compliance data, wherein the applying step comprises testing the compliance data to determine whether it conforms to the constraint data and thereby controlling the step of displaying the adapted component in the frame.

3. A method according to claim 2, wherein the constraint data comprises specification data specifying allowed components for the said frame, and the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed for the said frame.

4. A method according to claim 2 or 3, wherein the constraint data comprises specification data specifying at least one allowed orientation of at least one component for the said frame, wherein the applying step comprises disposing the component in a chosen orientation and the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen orientation for the said frame.

5. A method according to claim 2, 3 or 4, wherein the constraint data comprises specification data specifying at least one allowed disposition of at least one component for the said frame, wherein the applying step comprises disposing the component in a chosen disposition and the controlling step comprises enabling display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen disposition for the said frame.

6. A method according to any preceding claim comprising

selecting at least one further component from the library;

displaying the selected further component; and

applying the selected further component to the frame, wherein the applying step comprises accessing the dimension data of the frame;

adapting the further component to the frame; and

displaying the adapted further component in the frame.

7. A method according to any preceding claim further comprising modifying at least one of the size, orientation or disposition of the frame, whereby the or each displayed component varies correspondingly.

8. A method of deriving manufacturing data for a three-dimensional object comprising the method of any preceding claim, and further comprising outputting data derived from said adapted frame, as said manufacturing data.

9. A system constructed and arranged for modelling a three-dimensional object, the system comprising a component store for storing a library of components and a user input device operable to define a frame representing a three-dimensional space for the object, to select a component from the library of components and to apply the selected component to the frame;

a display screen for displaying the frame and displaying the selected component; and

a processor for running a stored program operable to derive dimension data for the frame, to access the dimension data of the frame, to adapt data representing the component to the dimension data of the frame and to provide the adapted data to the display screen whereby the display screen displays the adapted component in the frame as at least part of the object.

10. A system according to claim 9, further comprising a frame store for plural frame types, each said type having associated data representing constraints, wherein the user input device is operable to select a frame type from said plural frame types, and each component of said library of components has associated data representing compliance information, wherein the stored program is operable to test the compliance data of a selected component to determine whether it conforms to the constraint data of the selected frame type and thereby control the adaptation of said data representing the component to affect the display of the adapted component in the frame.

11. A system according to claim 10, wherein the constraint data comprises specification data specifying at least one of the group comprising:

allowed components for the said frame,

an allowed orientation of at least one component for the said frame type; and

an allowed disposition of at least one component for the said frame type.

12. A system according to claim 11, wherein the stored program is operable to adapt the component data if the compliance data of the selected component indicates that the selected component is allowed for the said frame type.

13. A system according to claim 11 or 12, wherein the user input device is arranged to allow a user to choose an orientation for the selected component, and the stored program is operable to adapt the component data to represent the chosen orientation to thereby enable display, if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen orientation for the said frame type.

14. A system according to claim 11, 12 or 13, wherein the user input device is arranged to allow a user to choose a disposition for the selected component, and the stored program is operable to adapt the component data of the selected component to represent the chosen disposition of the component to thereby enable display if the compliance data of the selected component indicates that the selected component is allowed to be in the chosen disposition for the said frame type.

15. A system according to any one of claims 9-14, wherein the user input device is operable to allow a user to modify at least one of the size, orientation and disposition of the frame, and the stored program is operable to correspondingly adapt the component data for the or each component displayed in the frame whereby the object displayed varies.

16. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for modelling roofs.

17. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for modelling vehicle interiors.

18. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for modelling aircraft interiors.

19. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for retail interiors such as shelves and racking.

20. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for furniture.

21. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for lighting and/or electrical installation.

22. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for buildings.

23. A method according to any of claims 1-8 or a system according to any of claims 9-15, specially adapted for gardens or parks.

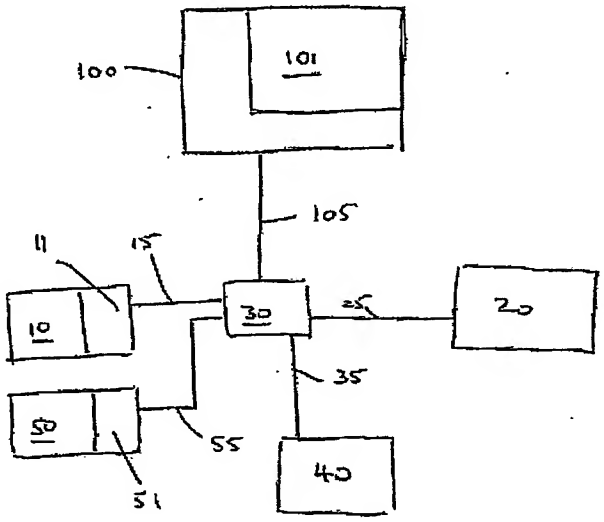


FIG 1

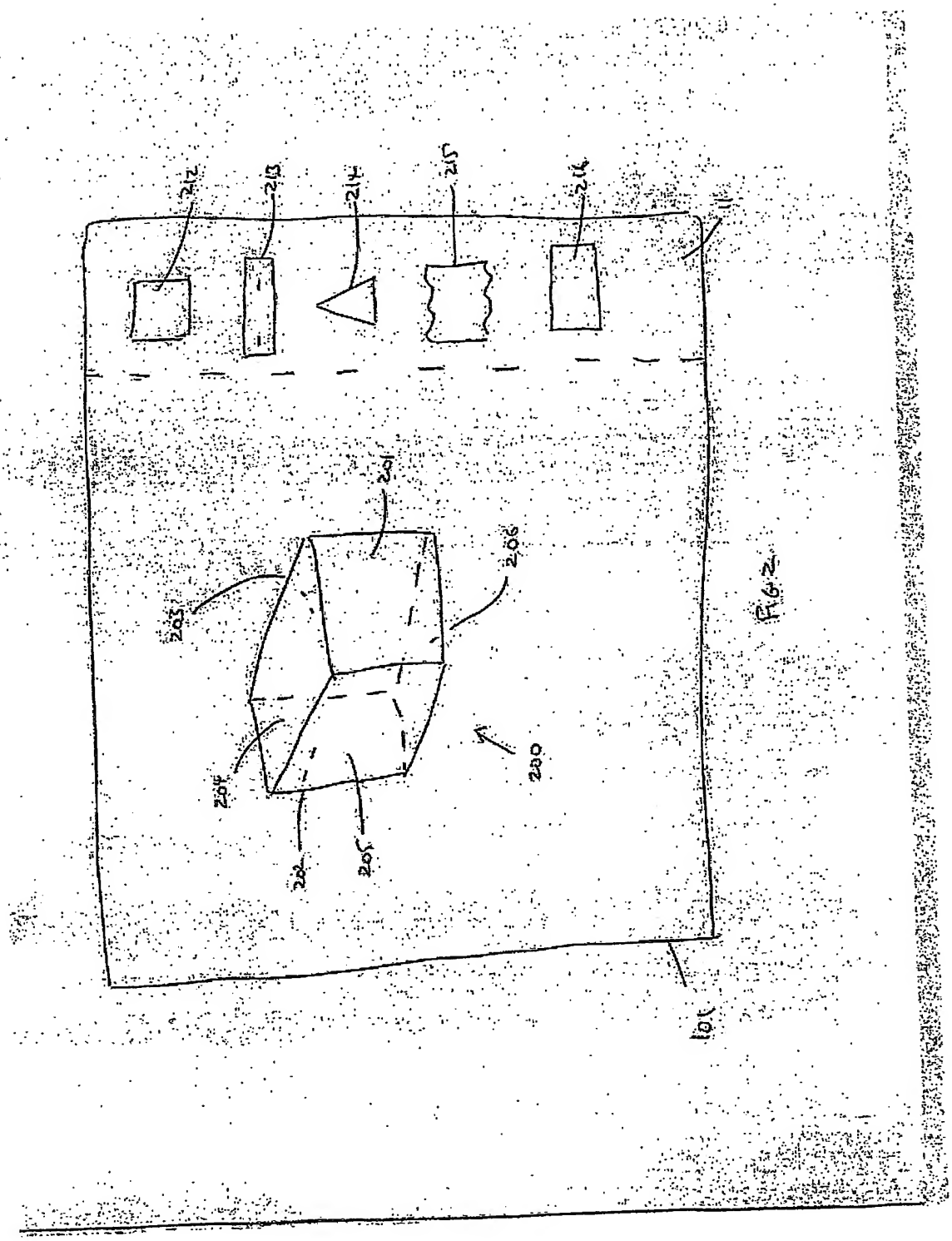


FIG 2

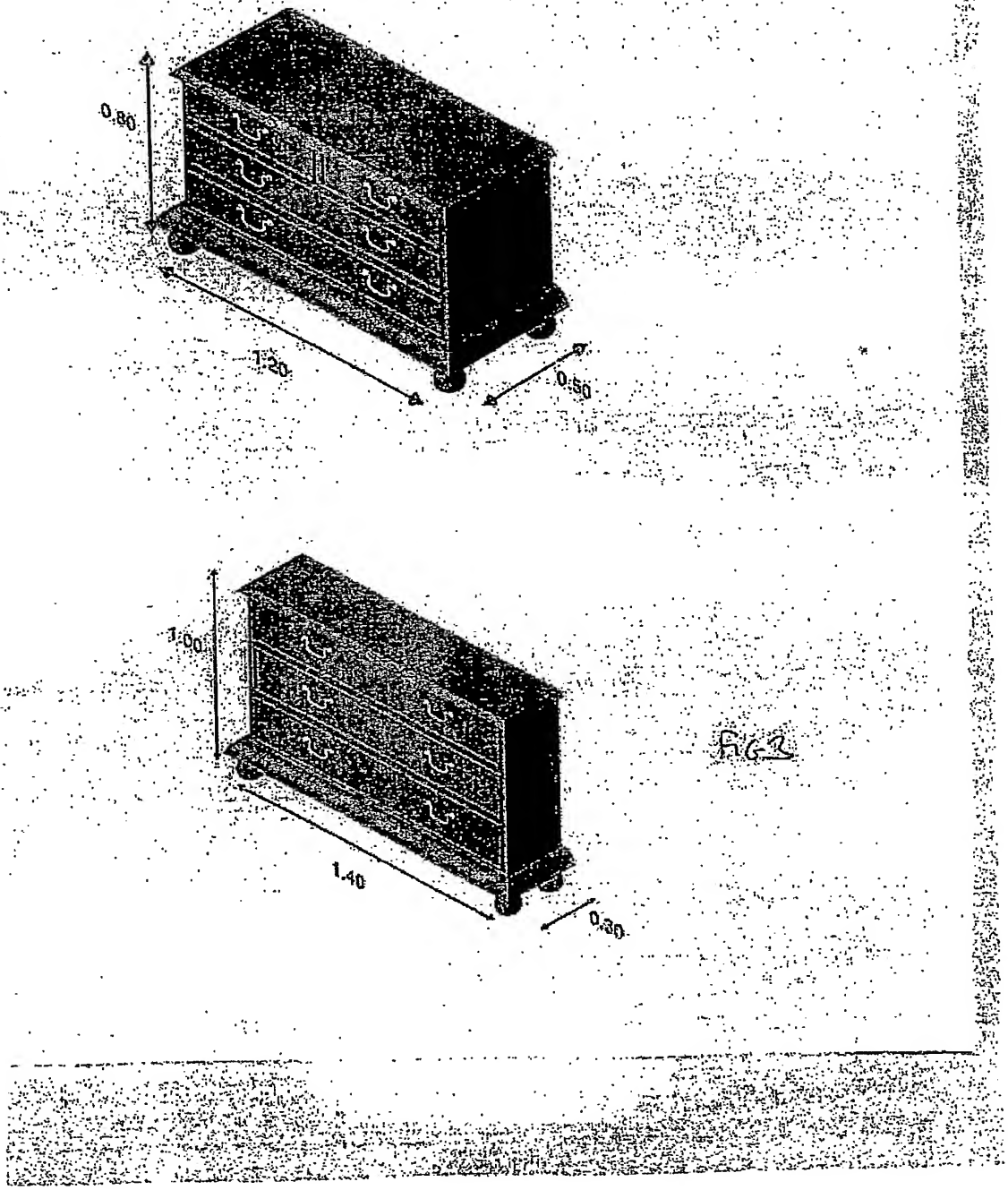
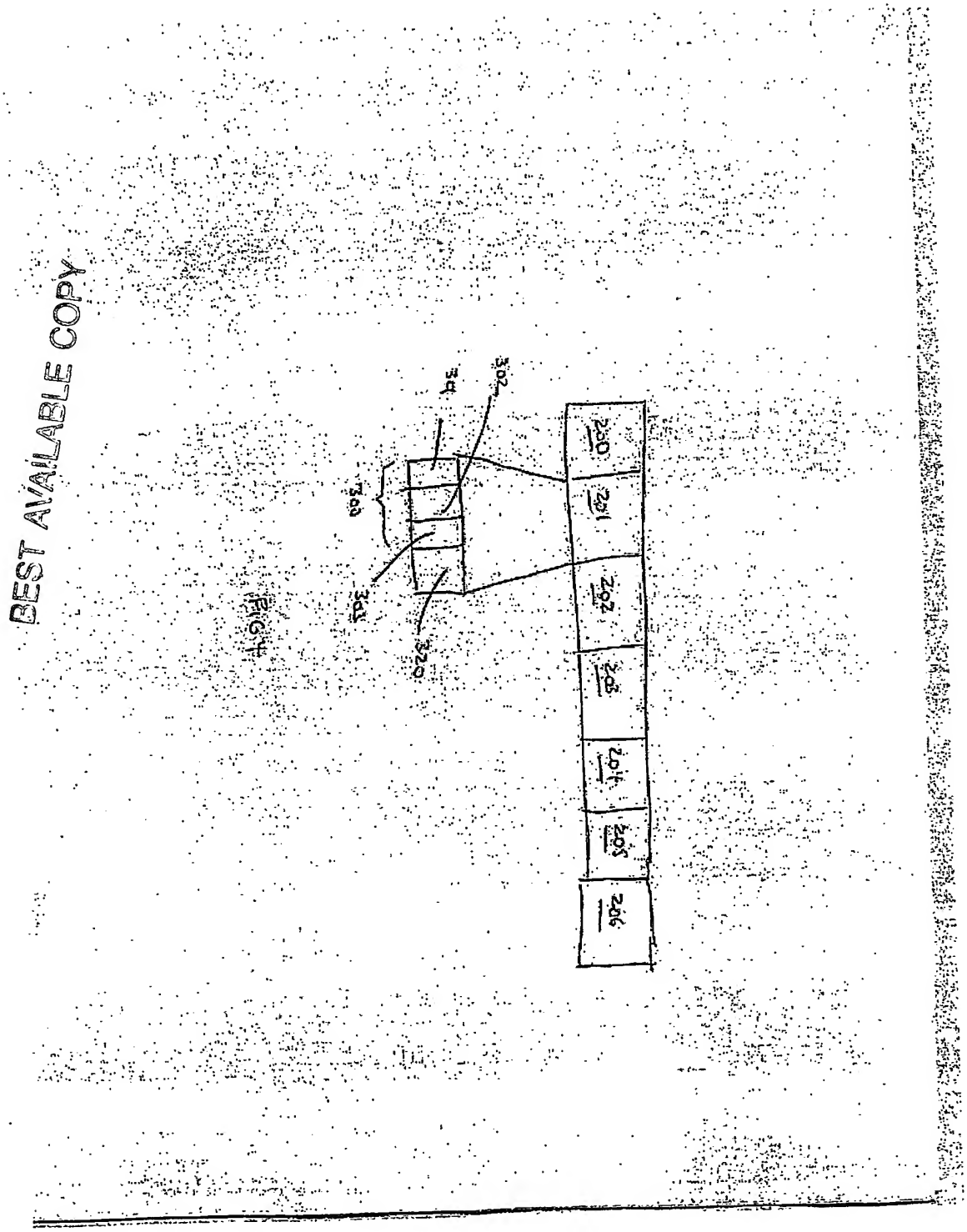


FIG 2



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